Faculty of Design

2013

Design flaws and service system breakdowns: Learning from systems thinking

Ing, David

Design Flaws and Service System Breakdowns: Learning from Systems Thinking

David Ing
International Society for the Systems Sciences,
Aalto University, and Healthcare EQ Inc.
October 2013

Agenda

A. Design thinking, systems thinking
- Service systems

B. Flaws in the design of service systems
- A starter set of 7 conditions

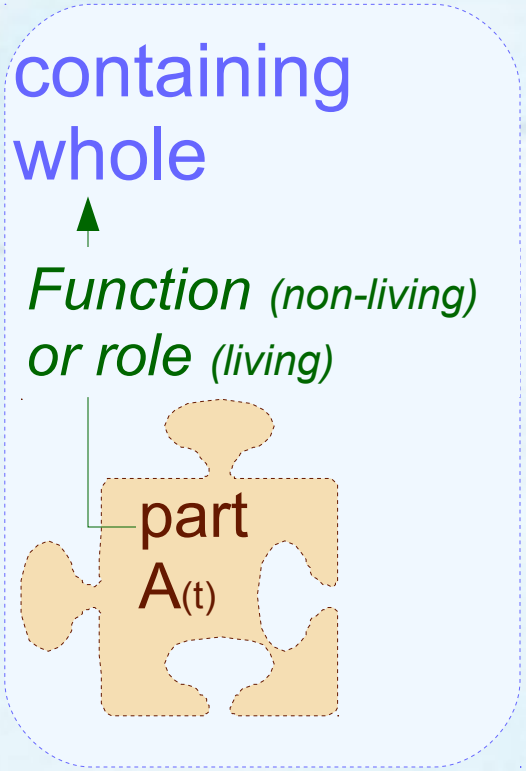
C. Paths forward?

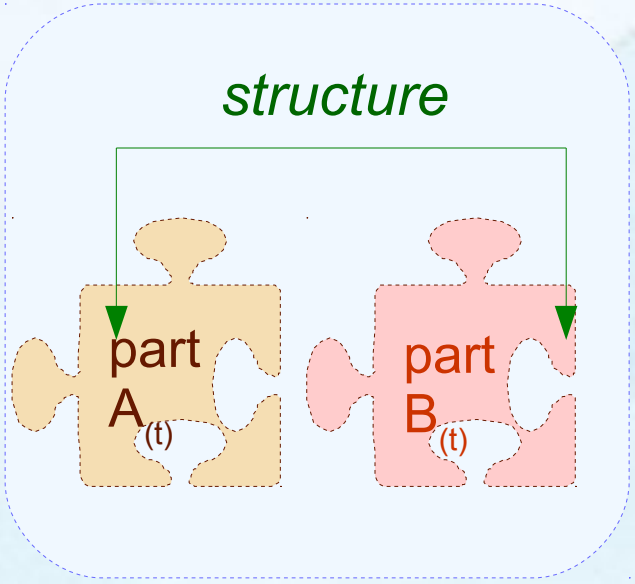
An integrated approach to problem resolution requires design thinkers to expand their understanding of good systems design principles with a purposeful consideration of the social systems they are working within [Pourdehnad, Wexler, Wilson (2011)]

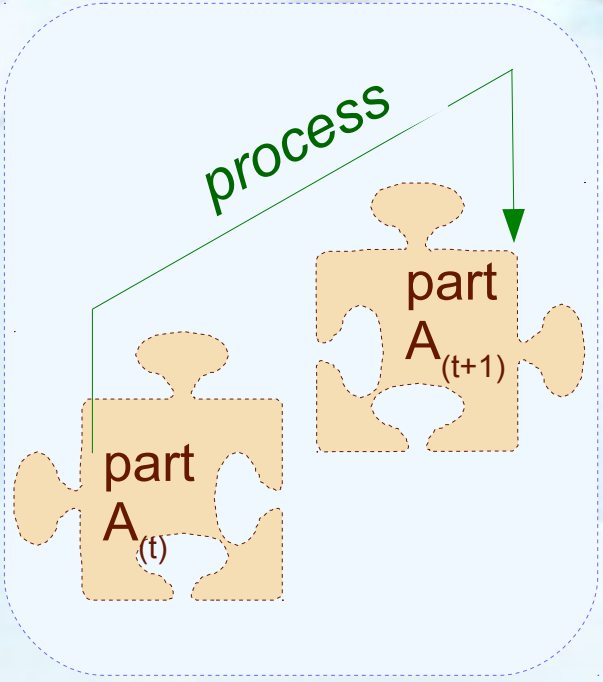
First Generation of Design (Olson, 1982)	Second Generation of Design (Goetze, 2010)	Third Generation of Design (proposed) (Pourdehnad, Wexler, Wilson 2011)
•Act of designing by "designers" •Professional holds knowledge critical to design •After design created, no obligation to go further •Throw design "over the wall"	•Need for collaboration among designers and external perspectives to guide them •Input from many stakeholders, including users •Design team observes and interacts with large system environment •Risk: Perspectives in parts, not whole •Risk: Unintended consequences when parts missed	•Stakeholders are the designers •People allowed to plan for themselves •Design facilitator creates an environment where differing views are honored within the context of the larger system •"Authentic engagement" taps creative energy of every participant

Source: Pourdehnad, John, Erica R. Wexler, and Dennis V. Wilson. 2011. "Systems & Design Thinking: A Conceptual Framework for Their Integration." Proceedings of the 55th Annual Meeting of the ISSS - 2011, Hull, UK 55 (1). http://journals.isss.org/index.php/proceedings55th/article/view/1650.

Systems thinking is a perspective on wholes, parts and their relations





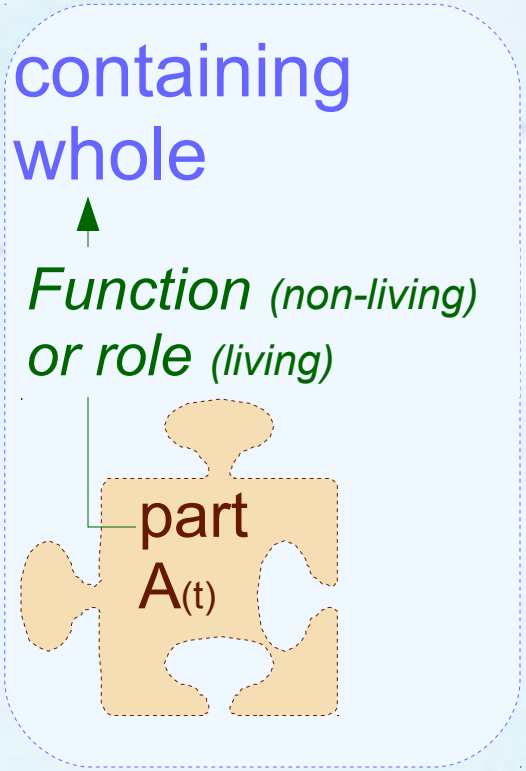


Function
"contribution of the part to the whole"

Structure
"arrangement in space"

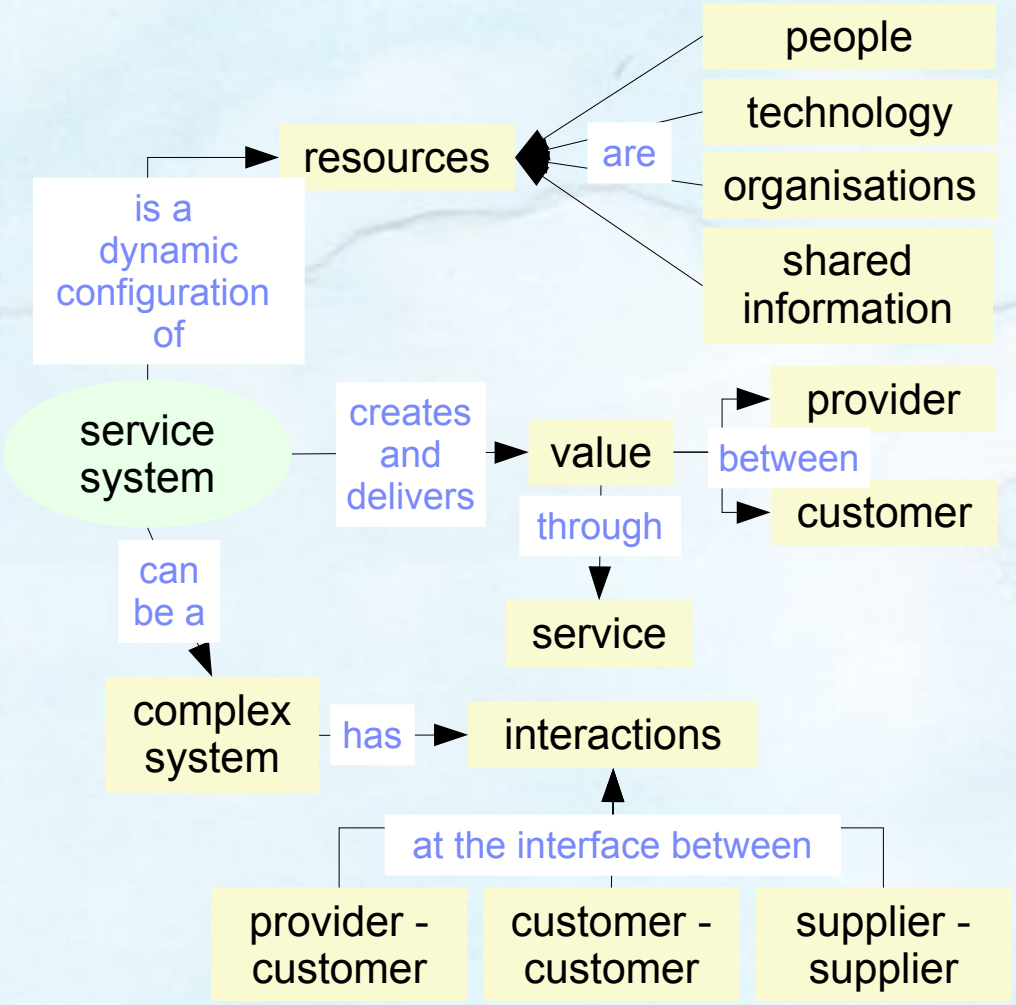
Process
"arrangement in time"

Systems thinking: synthesis precedes analysis
(Ackoff 1981)



Synthesis precedes analysis
1. Identify a containing whole (system) of which the thing to be explained is a part.
2. Explain the behavior or properties of the containing whole
3. Then explain the behavior or properties of the thing to the explained in terms of its role(s) or function(s) within its containing whole.

Service systems (Cambridge IfM and IBM, 2008)



A service system can be defined as a dynamic configuration of resources (people, technology, organisations and shared information) that creates and delivers value between the provider and the customer through service.

In many cases, a service system is a complex system in that configurations of resources interact in a non-linear way. Primary interactions take place at the interface between the provider and the customer. However, with the advent of ICT, customer-to-customer and supplier-to-supplier interactions have also become prevalent. These complex interactions create a system whose behaviour is difficult to explain and predict.
(IfM and IBM, 2008, p. 6)

Source: IfM, and IBM. 2008. *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government.* Cambridge, UK: University of Cambridge Institute for Manufacturing. http://www.ifm.eng.cam.ac.uk/ssme/ .

Agenda

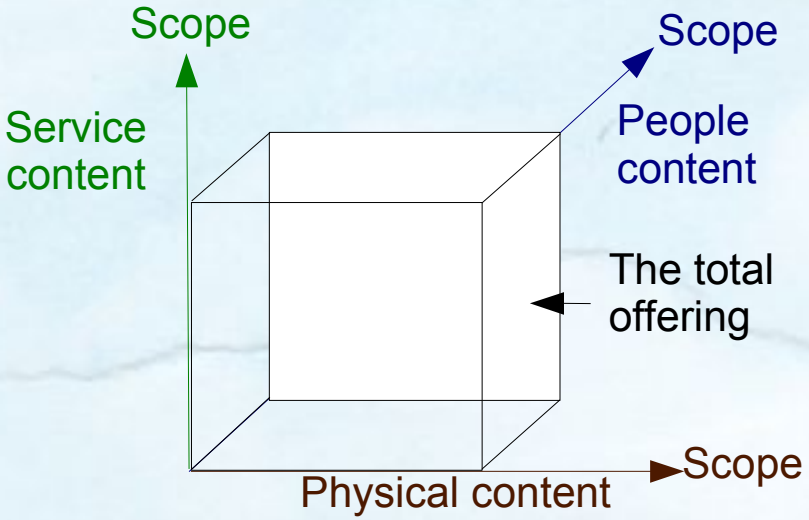
A. Design thinking, systems thinking
- Service systems

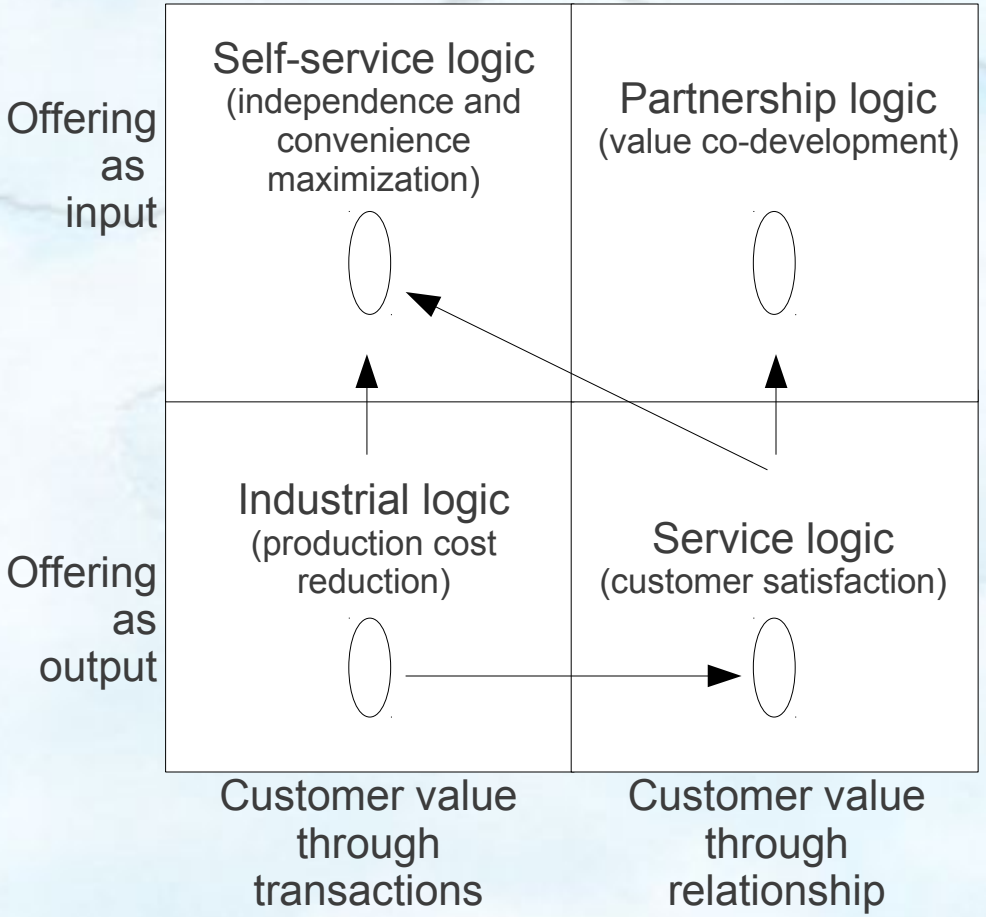
B. Flaws in the design of service systems
- A starter set of 7 conditions

C. Paths forward?

1. Activity package mismatch: Theory of the offering (Normann and Ramirez)
2. Coordination fumble: Language action perspective (Winograd and Flores)
3. Change target discord: Reactivism, inactivism, preactivism, interactivism (Ackoff)
4. Resource scaling collapse: Supply side sustainability (Allen, Hoekstra, Tainter)
5. Environmental context shift: Causal texture theory (Emery and Trist)
6. Pacing layers trap: Coevolution and learning (Brand, Bateson)
7. Regeneration failure: Panarchy (Holling and Gunderson)

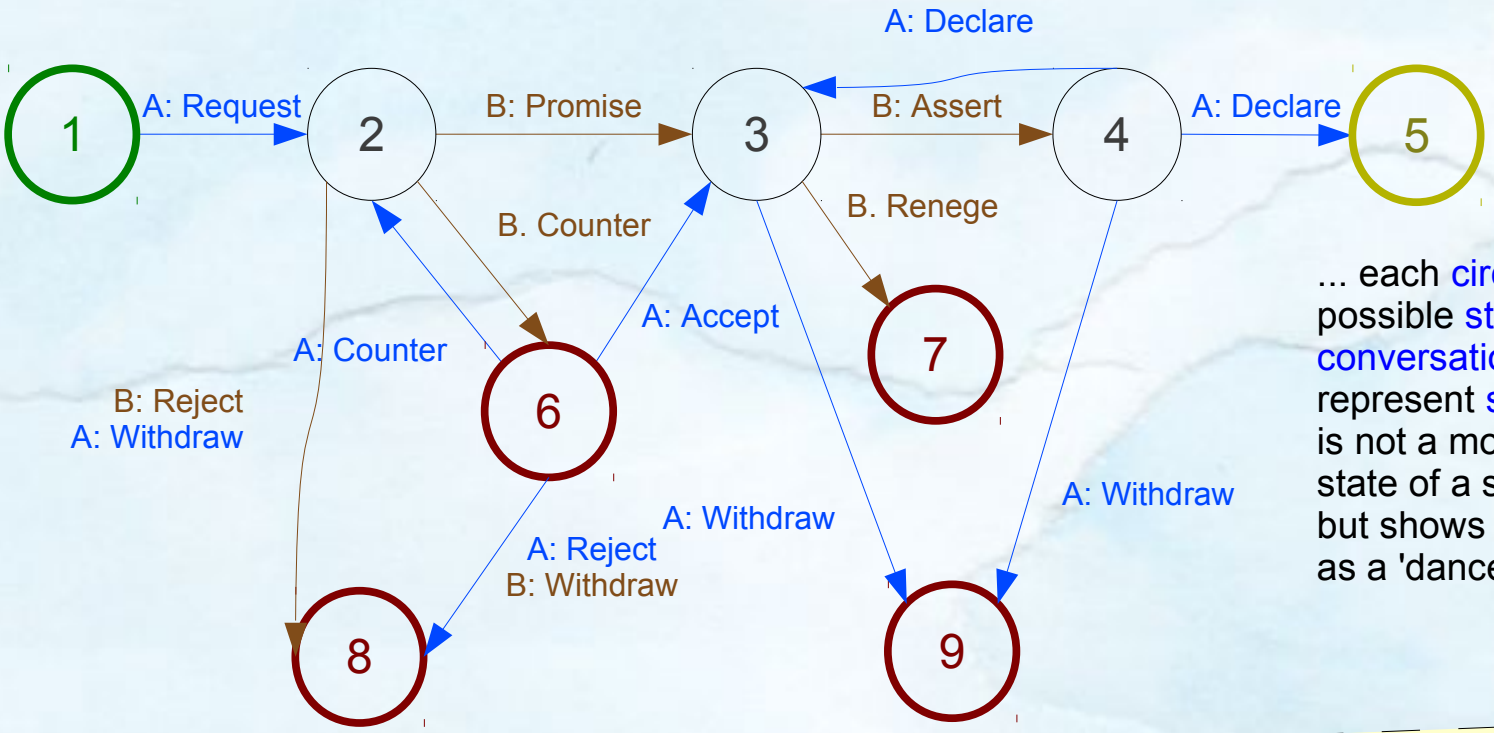
1. Activity package mismatch: Theory of the offering





Source: Rafael Ramírez and Johan Wallin. 2000. *Prime Movers: Define Your Business or Have Someone Define It Against You*. Chichester, England: Wiley.

2. Coordination fumble: Language action perspective

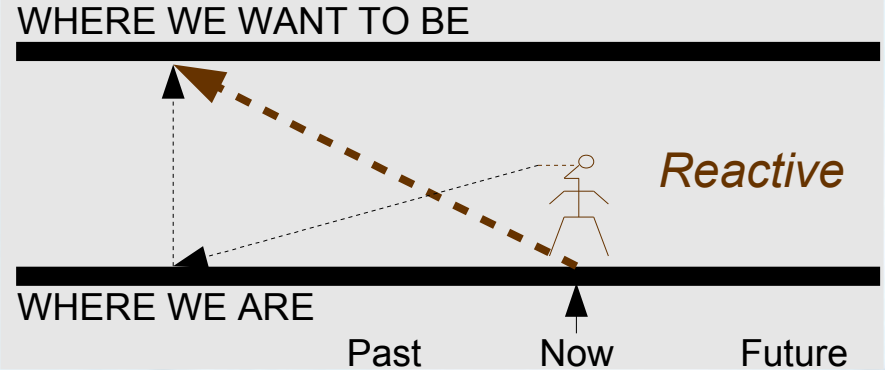


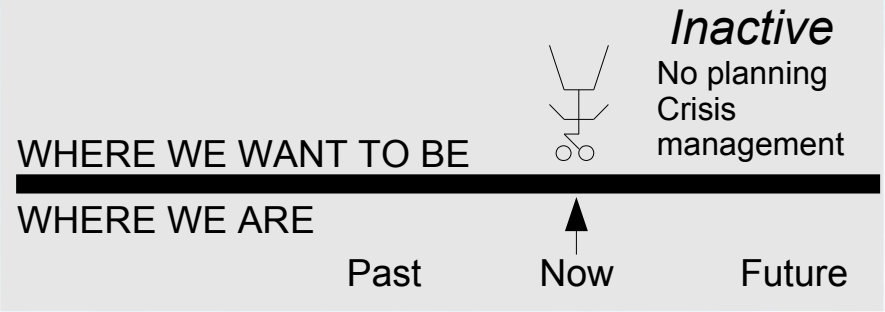
... each circle represents a possible state of the conversation and the lines represent speech acts. This is not a model of the mental state of a speaker or hearer, but shows the conversation as a 'dance.'

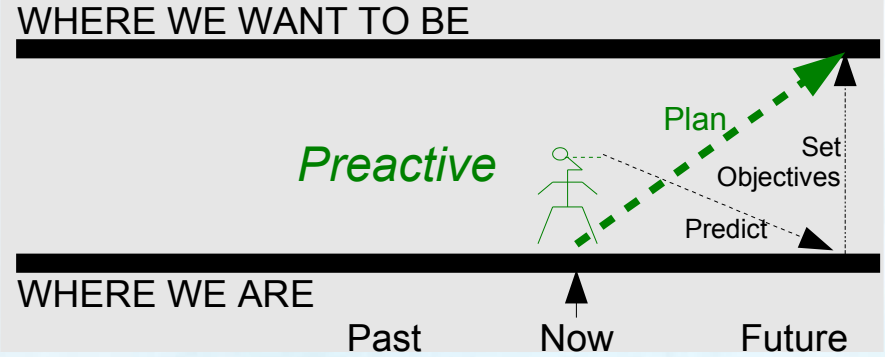
- Commitment to a deliverable
  - produce
- Commitment to a process
  - follow
- Commitment to a capability
  - provide
- Commitment to a relationship
  - contribute

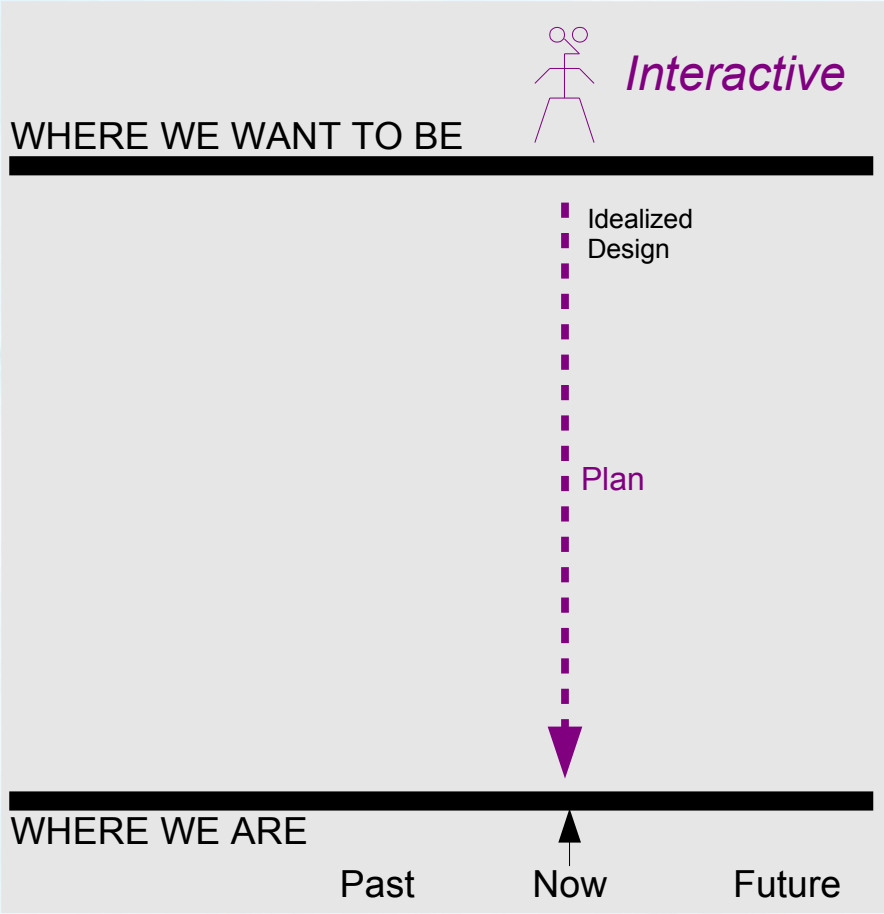
Source: Terry Winograd, and Fernando Flores. 1986. *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, NJ: Ablex; David Ing. 2008. "Offerings as Commitments and Context: Service Systems from a Language Action Perspective." In *Proceedings of the 12th International Conference of the UK System Society*. Oxford, UK.

3. Change target discord: Reactivism, inactivism, preactivism, interactivism



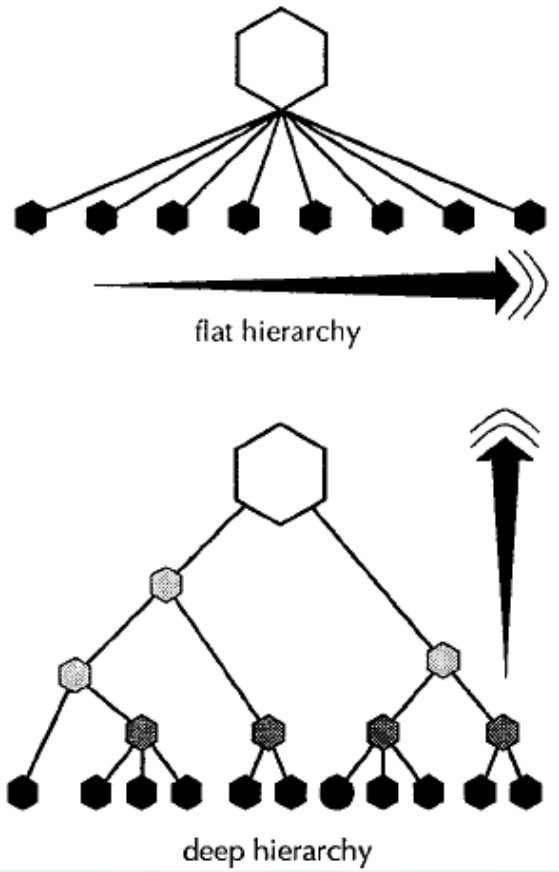






Source: Russell L. Ackoff. 1999. *Re-creating the Corporation: a Design of Organizations for the 21st Century*. Oxford University Press. http://books.google.ca/books?id=xylRdiAbpr8C .

4. Resource scaling collapse: Supply side sustainability



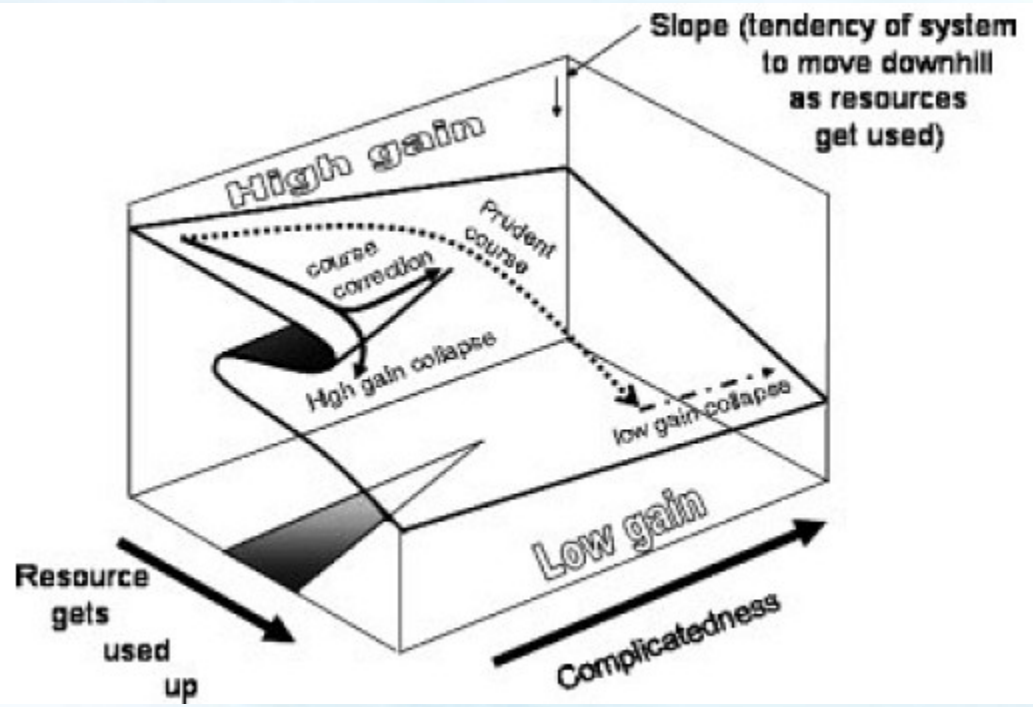
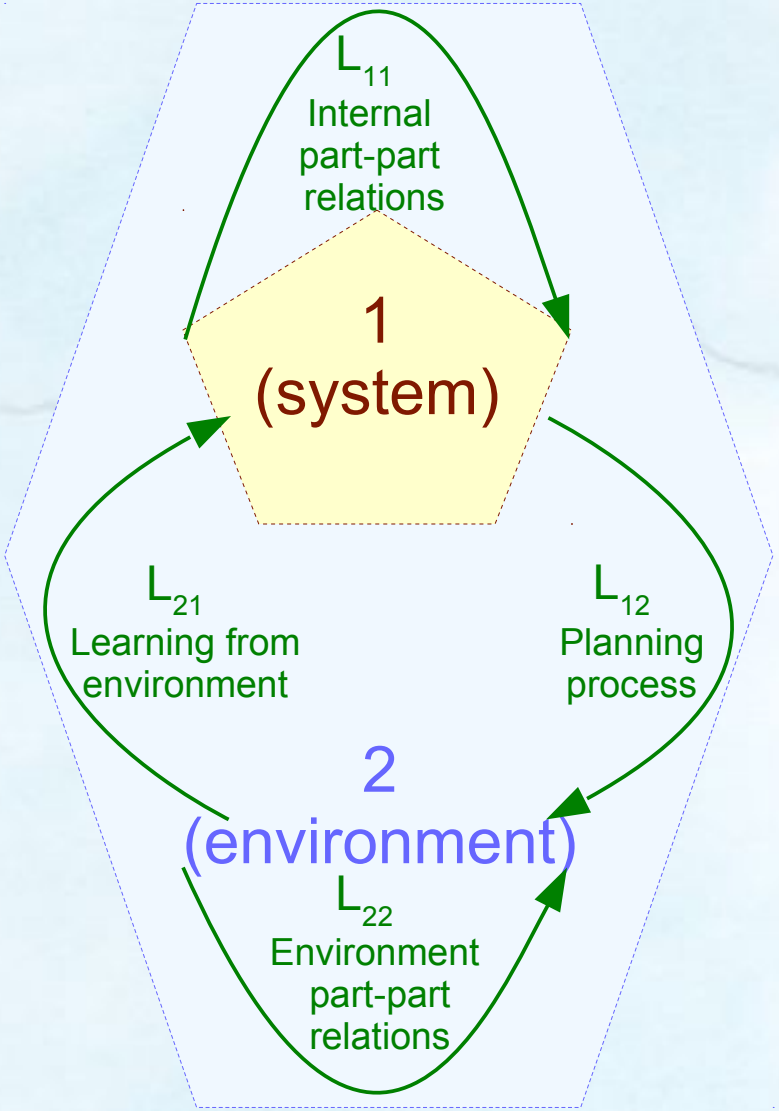


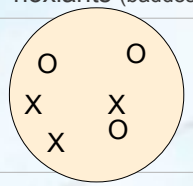
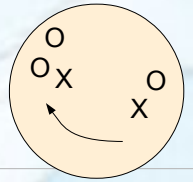
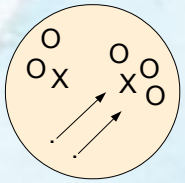
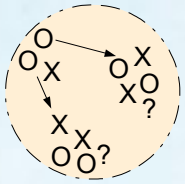
Figure 7. A representation of the tracks that lead from high to low to super low gain patterns. [Allen, Allen, Malek 2006]

Figure 3. The top hierarchy shows increases in complicatedness by increasing the structural elaboration. Structural elaboration is portrayed as widening the span in horizontal differentiation.
The bottom hierarchy shows increasing complexity, by an elaboration of organization. New levels appear as new constraints emerge as limits to the positive feedbacks of the emergent process. Elaboration or organization increases hierarchical depth. [Allen, Tainter, Hoekstra 1999]

Source: Timothy F. H. Allen, Joseph A. Tainter, and Thomas W. Hoekstra. 1999. "Supply-side Sustainability." *Systems Research and Behavioral Science* 16 (5): 403–427; Timothy F. H. Allen, Peter C. Allen, Amy Malek, John Flynn, and Michael Flynn. 2009. "Confronting Economic Profit with Hierarchy Theory: The Concept of Gain in Ecology." *Systems Research and Behavioral Science* 26 (5): 583–599.

5. Environmental context shift: Causal texture theory



	Where O = goals (goodies), X = noxiants (baddes)	
Type I. Random Placid		Goals and noxiants randomly distributed. Strategy is tactic. "Grab it if it's there". Largely theoretical of micro, design, e.g. concentration camps, conditioning experiments. Nature is not random.
Type 2. Clustered Placid		Goals and noxiants are lawfully distributed – meaningful learning. Simple strategy – maximize goals, e.g. use fire to produce new grass. Most of human span spent in this form. Hunting, gathering, small village. What people mean by the "good old days".
Type 3. Disturbed Reactive		Type 2 with two or more systems of one kind *competing* for the same resources. Operational planning emerges to out-manoeuvre the competition. Requires extra knowledge of both Ss and E. E is stable so start with a set of givens and concentrate on problem solving for win-lose games. Need to create insturments that are variety-reducing (foolproof) – elements must be standardized and interchangeable. Birth of bureacractic structures where people are redundant parts. Concentrate power at the top – strrategy becomes a power game.
Type 4. Turbulent		Dynamic, not placid/stable. Planned change in type 3 triggers off unexpected social processes. Dynamism arises from the field itself, creating unpredictability and increasing *relevant uncertainty* and *its continuities*. Linear planning impossible, e.g. whaling disrupted reproduciton, people react to being treated as parts of machine. Birth of open systems thinking, ecology, and catastrophe theory.

Source: Fred E. Emery, and Eric L. Trist. 1965. "The Causal Texture of Organizational Environments." *Human Relations* 18 (1) (February): 21–32. doi:10.1177/001872676501800103. http://dx.doi.org/10.1177/001872676501800103.

6. Pacing layers trap: Coevolution and learning

SITE

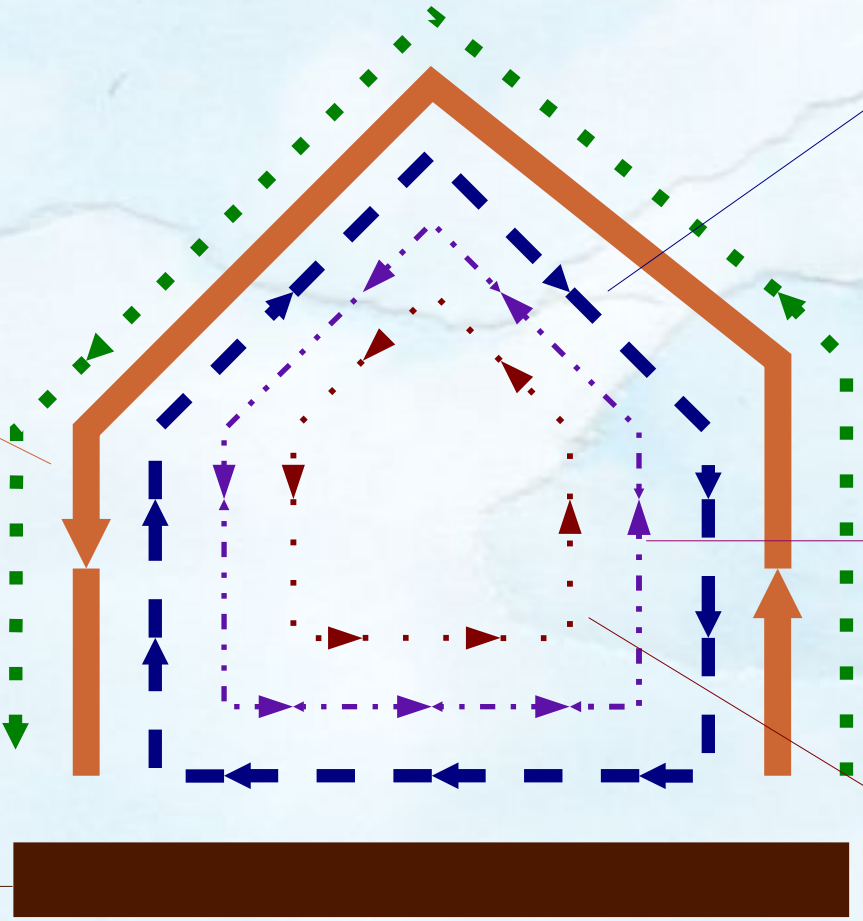
This is the geographical setting, the urban location, and the legally defined lot, whose boundaries outlast generations of ephemeral buildings. "Site is eternal", Duffy agrees.

STRUCTURE

The foundation and load-bearing elements are perilous and expensive to change, so people don't. These are the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

SKIN

Exterior surfaces now change every 20 years or so, to keep up with fashion or technology, or for wholesale repair. Recent focus on energy costs has led to re-engineered Skins that are air-tight and better-insulated.



SERVICES

These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilation, and air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.

SPACE PLAN

The interior layout, where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years; exceptionally quiet homes might wait 30 years.

STUFF

Chairs, desks, phones, pictures; kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called mobilia in Italian for good reason.

Source: Stewart Brand. 1994. *How Buildings Learn: What Happens after They're Built*. New York: Viking.

7. Regeneration failure: Panarchy

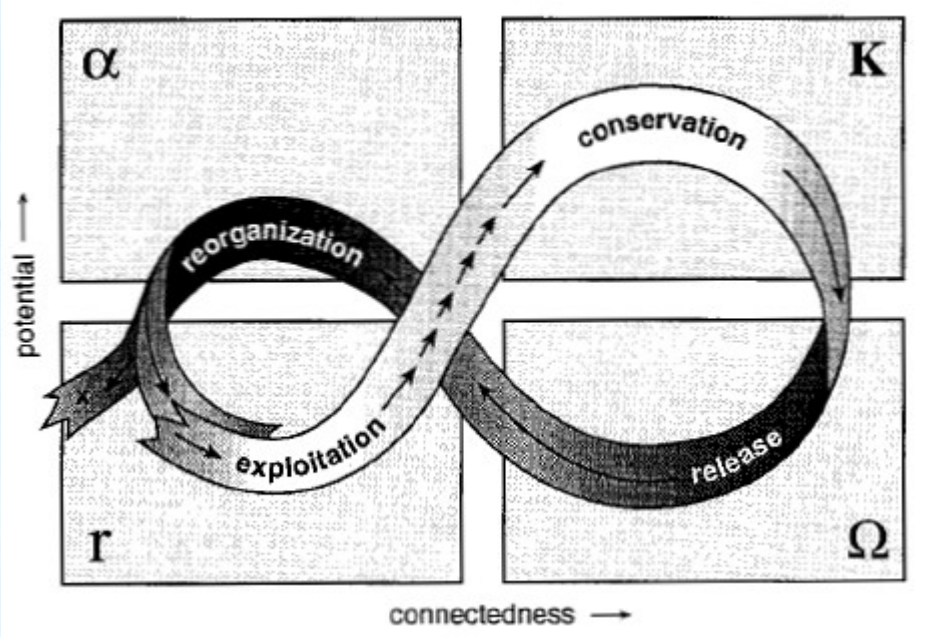


Figure 4. A stylized representation of the four ecosystem functions (r, K, Ω, α) and the flow of events among them.

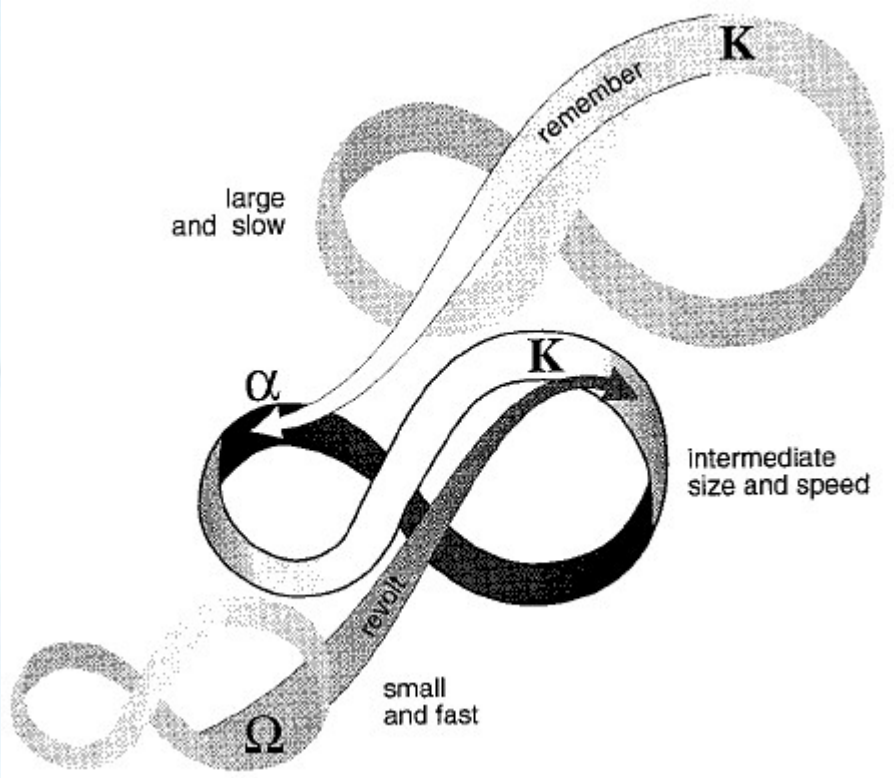


Figure 7. Panarchical connections. [....] the "revolt" connection ...can cause a critical change in one cycle to cascade up to a vulnerable stage in a larger and slower one. The ... "remember" connection ... facilitates renewal by drawing on the potential that has been accumulated and stored in a larger, slower cycle.

Source: C. S. Holling 2001. "Understanding the Complexity of Economic, Ecological, and Social Systems." *Ecosystems* 4 (5): 390–405. doi:10.1007/s10021-001-0101-5. http://dx.doi.org/10.1007/s10021-001-0101-5.

Agenda

A. Design thinking, systems thinking
   - Service systems

B. Flaws in the design of service systems
   - A starter set of 7 conditions

C. Paths forward?

Defining systems science(s) → science?

Primary intellectual virtue:	**Episteme**	**Techne**	**Phronesis**
Translation / interpretation:	Science (viz. epistemology)	Craft (viz. technique)	Prudence, common sense
Type of virtue:	Analytic scientific knowledge	Technical knowledge	Practical ethics
Orientation:	Research	Production	Action
Nature:	Universal	Pragmatic	Pragmatic
	Invariable (in time and space)	Variable (in time and space)	Variable (in time and space)
	Context-independent	Context-dependent	Context-dependent
Pursuits:	Uncovering universal truths	Instrumental rationality towards a conscious goal	Values in practice based on judgement and experience
Colloquial description:	**Know why**	**Know how**	**Know when, know where, know whom**

Patterns and Pattern Languages are ways to describe best practices, good designs, and capture experience in a way that it is possible for others to reuse this experience[1]

Pattern Name:

(Use italics for pattern names per Meszaros).

Aliases:

(Aliases, or none)

Problem

Give a statement of the problem that this pattern resolves. The problem may be stated as a question.

Context

Describe the context of the problem.

Forces

Describe the forces influencing the problem and solution. This can be represented as a list for clarity.

- Force one
- Force two

Solution

Give a statement of the solution to the problem.

Resulting Context

Describe the context of the solution.

Rationale

Explain the rationale behind the solution.

Known Uses

List or describe places where the pattern is used.

Related Patterns

List or describe any related patterns.

Source: [1] “Patterns”, The Hillside Group, http://hillside.net/patterns ; [2] “Writing Patterns”, AG's HTML template at http://hillside.net/index.php/ag-template ; “Canonical Form” (for writing patterns) at http://c2.com/cgi/wiki?CanonicalForm

Here is a short and necessarily incomplete definition of a pattern:

A recurring structural configuration that solves a problem in a context, contributing to the wholeness of some whole, or system, that reflects some aesthetic or cultural value.[1]

Pattern Name: A name by which this problem/solution pairing can be referenced

Problem
The specific problem that needs to be solved.

Context
The circumstances in which the problem is being solved imposes constraints on the solution. The context is often described via a "situation" rather than stated explicitly.

Forces
The often contradictory considerations that must be taken into account when choosing a solution to a problem.

Solution
The most appropriate solution to a problem is the one that best resolves the highest priority forces as determined by the particular context.

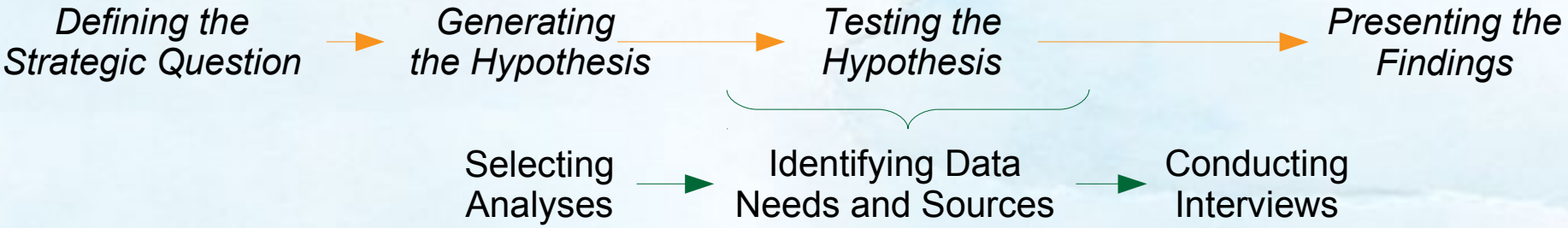
Resulting Context
The context that we find ourselves in after the pattern has been applied. It can include one or more new problems to solve

Rationale
An explanation of why this solution is most appropriate for the stated problem within this context.

Related Patterns
The kinds of patterns include:
- Other solutions to the same problem,
- More general or (possibly domain) specific variations of the pattern,
- Patterns that solve some of the problems in the resulting context (set up by this pattern)

Source: [1] Coplien, James O., and Neil B. Harrison. 2004. Organizational Patterns of Agile Software Development. Prentice-Hall, Inc. http://books.google.ca/books?id=6K5QAAAAMAAJ . [2] Gerard Meszaros and Jim Doble, “A Pattern Language for Pattern Writing”, Pattern Languages of Program Design (1997), http://hillside.net/index.php/a-pattern-language-for-pattern-writing

Hypothesis Driven Thinking [slide 1 of 2]



Source: Jeanne M. Liedtka, “Using Hypothesis-Driven Thinking in Strategy Consulting”, UVA-BP-0486, University of Virginia Darden School Foundation

Hypothesis Driven Thinking [slide 2 of 2]

1. Define the problem / question.
What is the big question or questions that need to be answered?
Usually the strategic problem has to do with the existence of a gap between what the client wants ... and what the client has. Thus, our focus is ultimately on making a recommendation (the design hypothesis) about the actions that the client should take to close that gap).
2. If needed, gather preliminary data that allows construction of initial hypotheses about the causes of and answers to the question.

3. Develop a set of competing descriptive hypotheses about the causes and their associated prescriptive hypotheses.
Example: The bank's profitability problems could be caused by

Descriptive Hypothesis	→	Prescriptive (Design) Hypothesis
Unattractive industry structure	→	exit industry
Lack of appropriate strategic capabilities	→	develop appropriate ones
Selection of less profitable target markets	→	select new ones

Defining the Strategic Question → *Generating the Hypothesis* → *Testing the Hypothesis* → *Presenting the Findings*

4. Select the most promising descriptive hypothesis for testing.

Selecting Analyses → Identifying Data Needs and Sources → Conducting Interviews

5. Identify the analysis that needs to be performed and design the study needed to collect the data.

6. Collect the data.

7. Using the data, test the hypothesis. Is it supported or rejected?
8. Resolve any anomalies or disconfirming data by gathering additional data and reformulating hypotheses, or by moving to an alternative hypothesis to begin new testing, as necessary.

9. Structure an argument that lays out the supporting logic for the design hypothesis.

Source: Jeanne M. Liedtka, "Using Hypothesis-Driven Thinking in Strategy Consulting", UVA-BP-0486, University of Virginia Darden School Foundation

Action Research [slide 1 of 4]

Criteria	Action research
Philosophical basis	Gestalt psychology, pragmatism, democracy
Purpose	Social change through involvement and improvement
Time frame of change	Both short- and long-term
Depth of change	Intrapersonal through cultural, ranging from shallow to deep
Epistemology	Knowing through doing; making and applying discoveries
Nature of discourse	Collaborative discourse of action and problem-solving; use of data-based, actionable knowledge
Ideology	Focusing on participation, involvement, and empowerment of organizational members affected by the problem; reeducative
Methodology	Iterative cycles of problem defining, data collection, taking action or implementing a solution, followed by further testing
Facilitator role	Primary functions as research/process guide
Level of inference	Focusing on data encourages low levels of inference, but reeducation process encourages higher level testing
Personal risk	Moderate risk, but ultimately depends upon organizational culture, consequences, visibility, and degree of sanction
Organizational risk	Depends upon strategic importance of the problem chosen, may entail less risk than doing nothing
Assessment	Validity based on appropriateness of method and on the extent to which the original problem is solved
Learning level	Varies based on nature of project, skills, and risk-taking of participants

The six action strategies include: action research, participatory research, action learning, action science, developmental action inquiry, and cooperative inquiry. To explain each briefly:

action research, itself, constitutes a process wherein researchers participate in studies both as subjects and objects with the explicit intention of bringing about change through the research process.

Participatory research, sometimes also referred to as the 'Southern School', is concerned with knowledge and power. It seeks collaboration between those from privileged groups who often control the production of knowledge and those among the economically disadvantaged who by questioning the dominant values within society can press for social change.

Action learning is based on the straightforward pedagogical notion that people learn most effectively when working on real-time problems occurring in their own work setting.

Action science is an intervention method based on the idea that people can improve their interpersonal and organizational effectiveness by exploring the hidden beliefs that drive their actions.

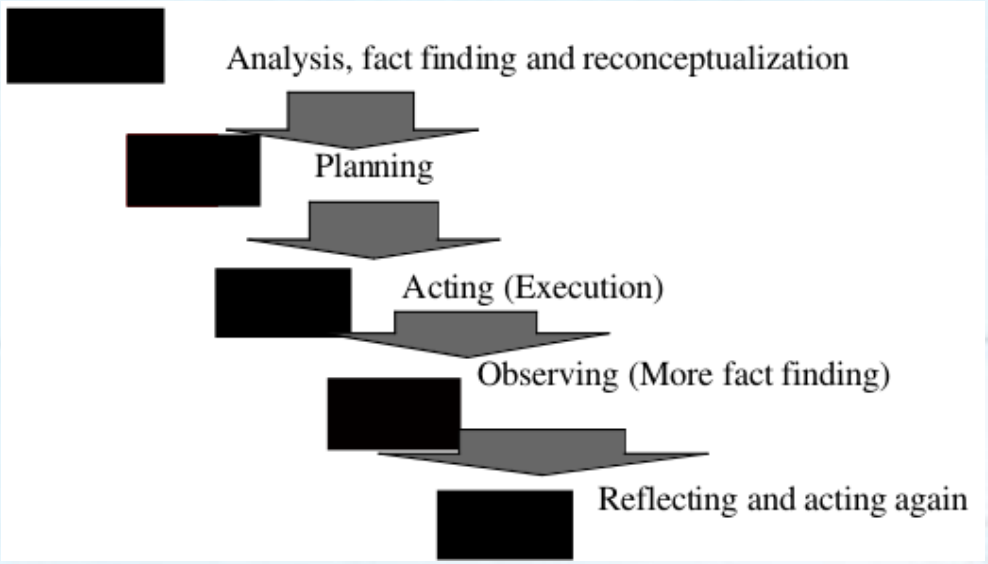
Developmental action inquiry is the systematic attempt to enrich a person's, group's, organization's, or society's awareness of the interplay among transpersonal awareness, subjective interpretations and strategies, intersubjective practices and politics, and objective data and effects.

Finally, in cooperative inquiry all those involved in the research are both coresearchers, generating ideas and designing and managing the project; and also co-subjects, participating in the activity that is being researched.

Source: Joe Raelin, "Preface to Special Issue on The Action Dimension in Management: Diverse Approaches to Research, Teaching and Development", *Management Learning*, v. 30, n2, pp. 115-125 June 1999, http://dx.doi.org/10.1177/1350507699302001

Action Research [slide 2 of 4]

Figure 1 Lewin's action research model



Lewin conceived of action research as a cycling back and forth between ever deepening surveillance of the problem situation (within the persons, the organization, the system) and a series of research-informed action experiments.

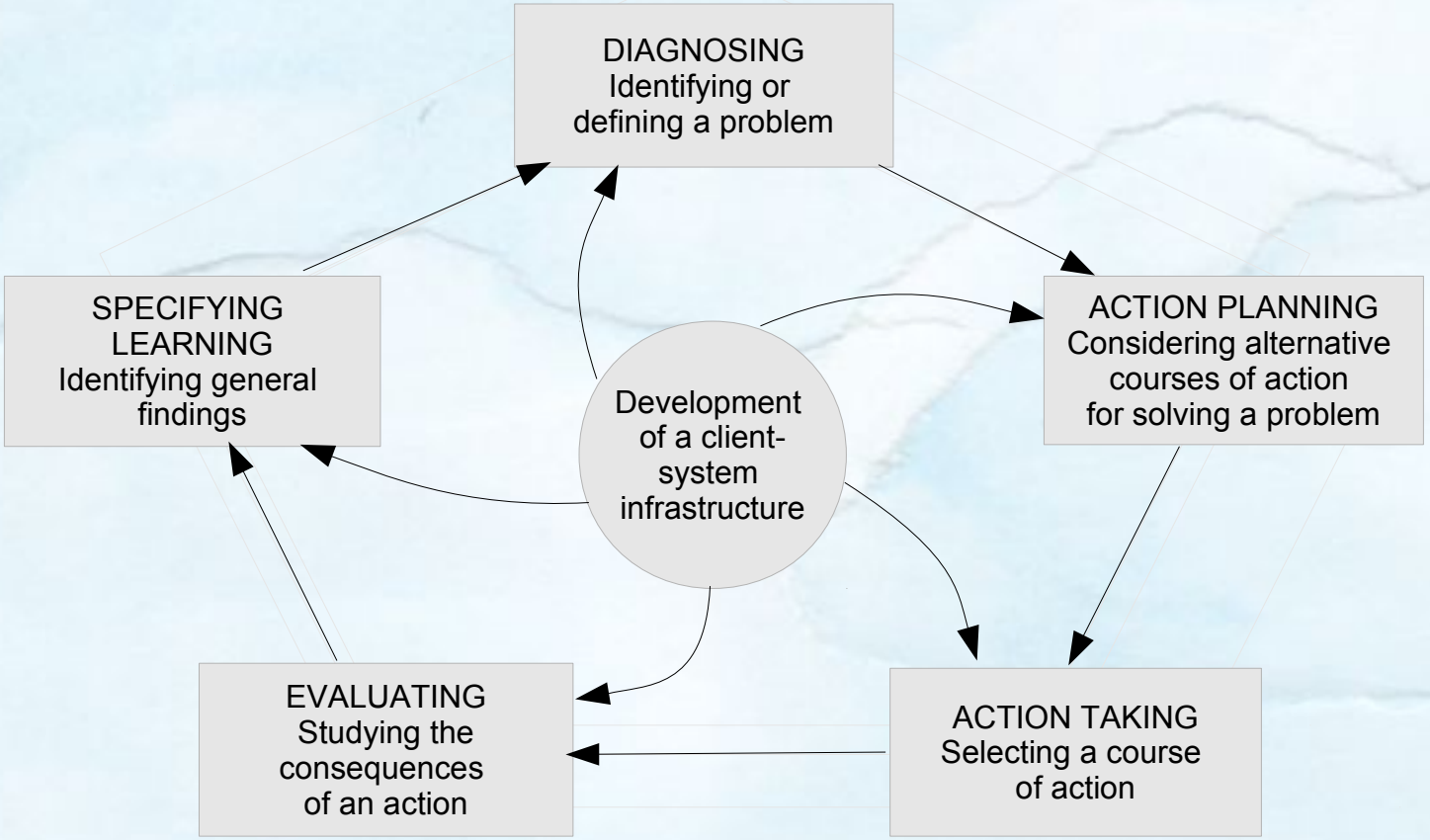
His original formulation of action research 'consisted in analysis, fact-finding, conceptualisation, planning, execution, more fact-finding or evaluation; and then a repetition of this whole circle of activities; indeed a spiral of such circles'.

Although Lewin first formulated the definition, he left scant work to describe and expand his early definitions.

The classical model of action research can be described or defined with five minimum characteristics:	
1. Purposes and Value Choice	Action research ... rejects the idea that science is completely value free. ... What is studied, how, who makes sense of data, and who learns are all imporant issues ...
2. Contextual focus	Problem definition is not limited to the concepts, theories, and epistemology of a particular discipline, but rather is grounded in the participants' definition of context
3. Change Based Data and Sense Making	Since action research is change oriented, it requires data that help track the consequences of intended change. So, action research must have data collected systemically over time.
4. Participation in the Research Process	It requires those who experience or "own" the real world problem to be actively involved ... at least in selecting the problem and sanctioning the search for solutions.
5. Knowledge diffusion	Diffusion ... occurs via new methods by which participants are directly involved in creating new knowledge which they then act on, involve others ...

Source: Linda Dickens and Karen Watkins, "Action Research: Rethinking Lewin", *Management Learning*, v. 30, n2, pp. 127-140 June 1999, http://dx.doi.org/10.1177/1350507699302002; Max Elden and Rupert F. Chisholm, "Emerging Varieties of Action Research", *Human Relations* 1993, v46, p121 http://dx.doi.org/10.1177/001872679304600201

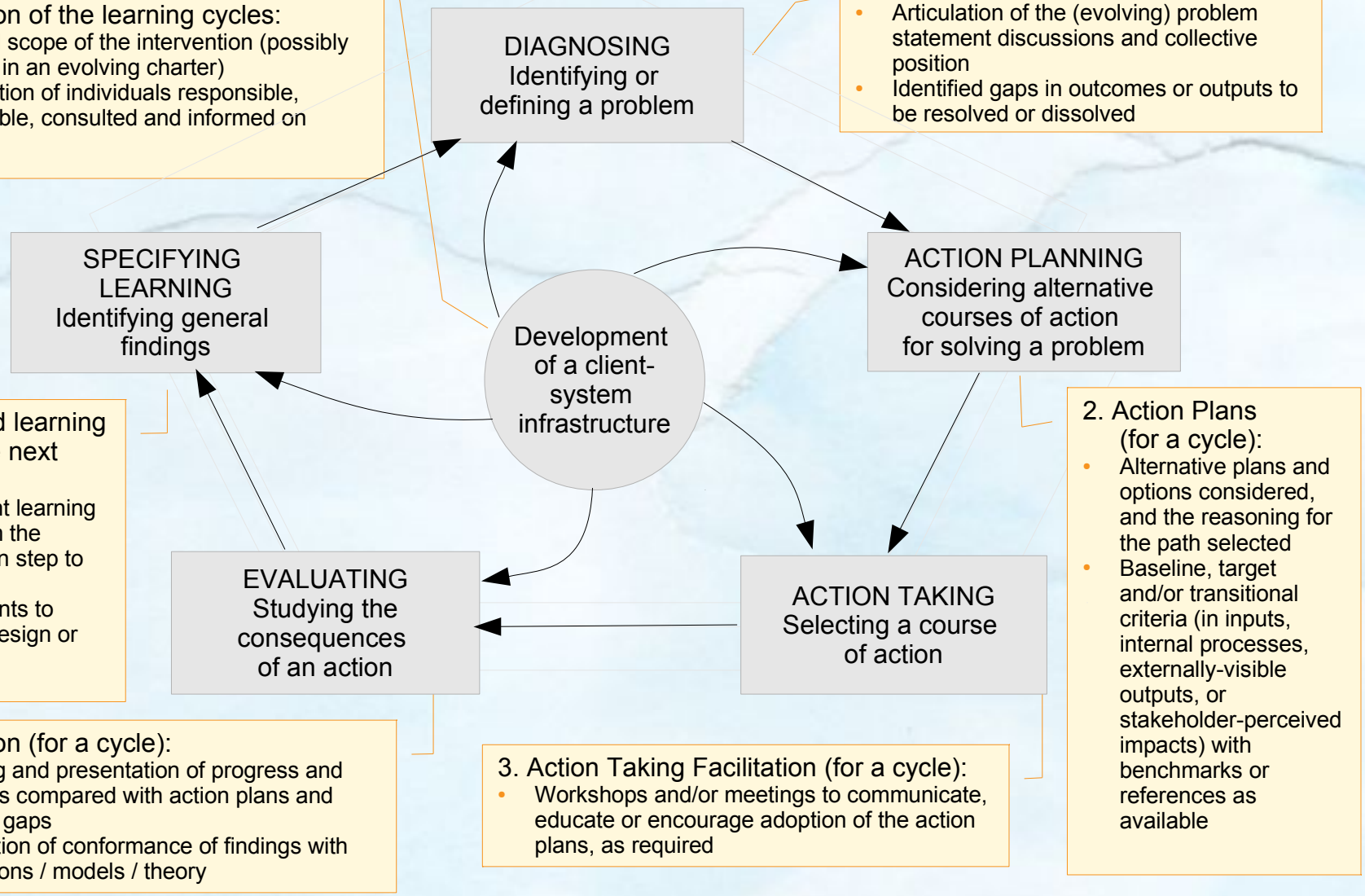
Action Research [slide 3 of 4]



Source: Gerald I. Susman and Roger D. Evered. 1978. “An Assessment of the Scientific Merits of Action Research.” *Administrative Science Quarterly* 23 (4): 582–603. http://www.jstor.org/stable/10.2307/2392581.

Action Research [slide 4 of 4]

0. Definition of the governing group, for regulation of the learning cycles:
- Expected scope of the intervention (possibly recorded in an evolving charter)
- Specification of individuals responsible, accountable, consulted and informed on progress



1. Diagnosis (for a cycle):
- Articulation of the (evolving) problem statement discussions and collective position
- Identified gaps in outcomes or outputs to be resolved or dissolved

2. Action Plans (for a cycle):
- Alternative plans and options considered, and the reasoning for the path selected
- Baseline, target and/or transitional criteria (in inputs, internal processes, externally-visible outputs, or stakeholder-perceived impacts) with benchmarks or references as available

3. Action Taking Facilitation (for a cycle):
- Workshops and/or meetings to communicate, educate or encourage adoption of the action plans, as required

4. Evaluation (for a cycle):
- Gathering and presentation of progress and results, as compared with action plans and identified gaps
- Examination of conformance of findings with expectations / models / theory

5. Specified learning (into the next cycle):
- Document learning from from the evaluation step to suggest adjustments to system design or policies

Source: Gerald I. Susman and Roger D. Evered. 1978. “An Assessment of the Scientific Merits of Action Research.” *Administrative Science Quarterly* 23 (4): 582–603. http://www.jstor.org/stable/10.2307/2392581.

Agenda

A. Design thinking, systems thinking
- Service systems

B. Flaws in the design of service systems
- A starter set of 7 conditions

C. Paths forward?

1. Activity package mismatch: Theory of the offering (Normann and Ramirez)
2. Coordination fumble: Language action perspective (Winograd and Flores)
3. Change target discord: Reactivism, inactivism, preactivism, interactivism (Ackoff)
4. Resource scaling collapse: Supply side sustainability (Allen, Hoekstra, Tainter)
5. Environmental context shift: Causal texture theory (Emery and Trist)
6. Pacing layers trap: Coevolution and learning (Brand, Bateson)
7. Regeneration failure: Panarchy (Holling and Gunderson)

